

The Developing Camelina Industry in the Western United States

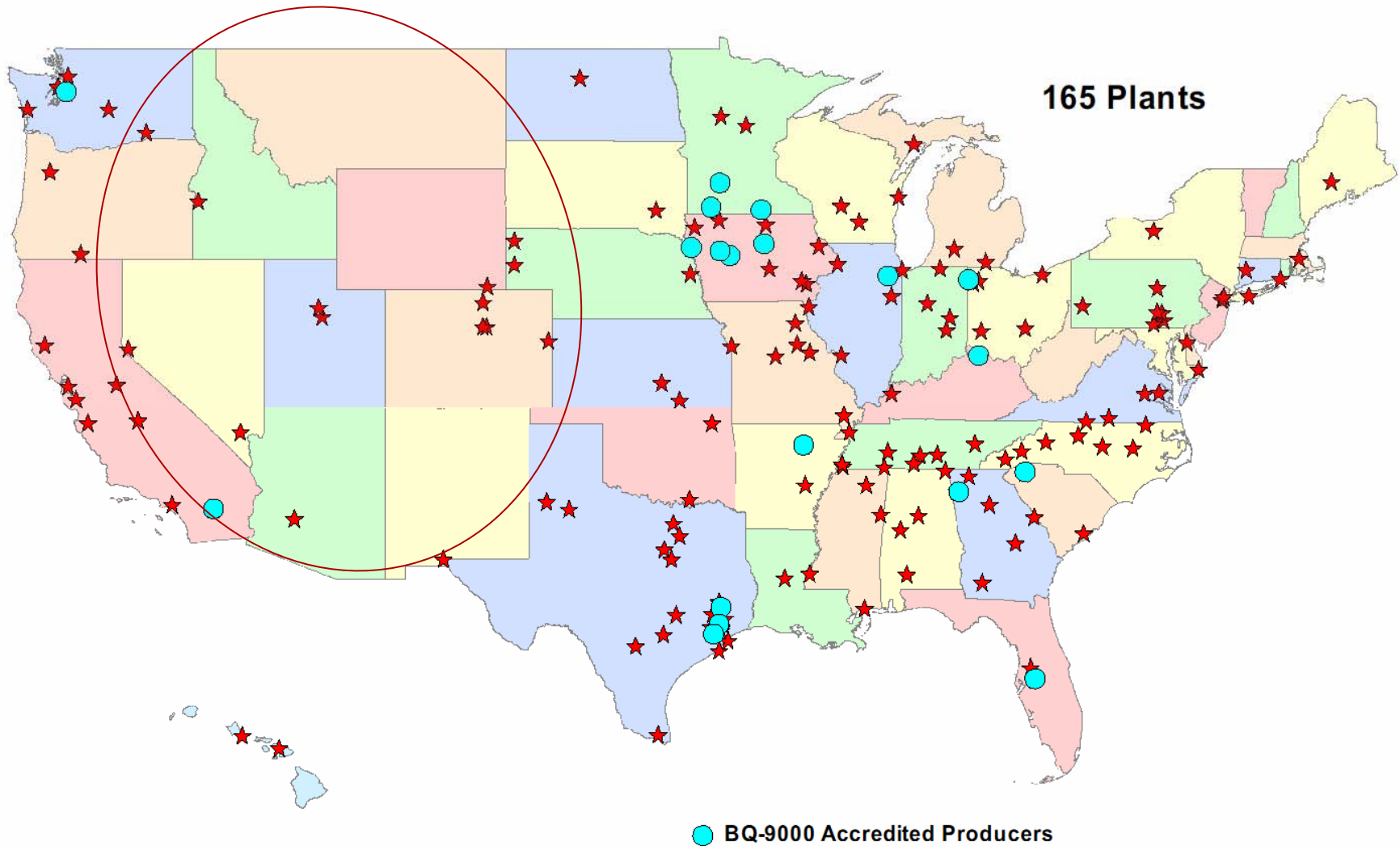
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**Great Plains Oil &
Exploration
Bigfork, Montana
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Geography- by Westerners

Commercial Biodiesel Production Plants (September 7, 2007)



'BQ' Denotes BQ-9000 Accredited Producers

Agronomic Research in Camelina: Minnesota (Putnam)

- *Univ. of Minnesota (Robbie Robinson):*
 - Defined agronomics and development of lines and cultivars suitable to the U.S.
 - No discernable pests, reduced weed presence
 - Yield increase with early planting in no-till wheat stubble (December-February)
 - A low input crop with no current market
 - A crop very adaptable to the arid west

The 1990s: Camelina Gets a Second Look

- **The world discovers petroleum has a value greater than \$65/barrel and we'll all be paying “more than \$2.00 !” for gas and diesel**
- **Cheap oil comes to an end**
- **Bio-based Fuels: a crop capable of growing on little input with maximum return on investment**
- **The world discovers Omega 3 fatty acids reduce inflammation of the brain and heart**

Montana Camelina Research in the 21st Century

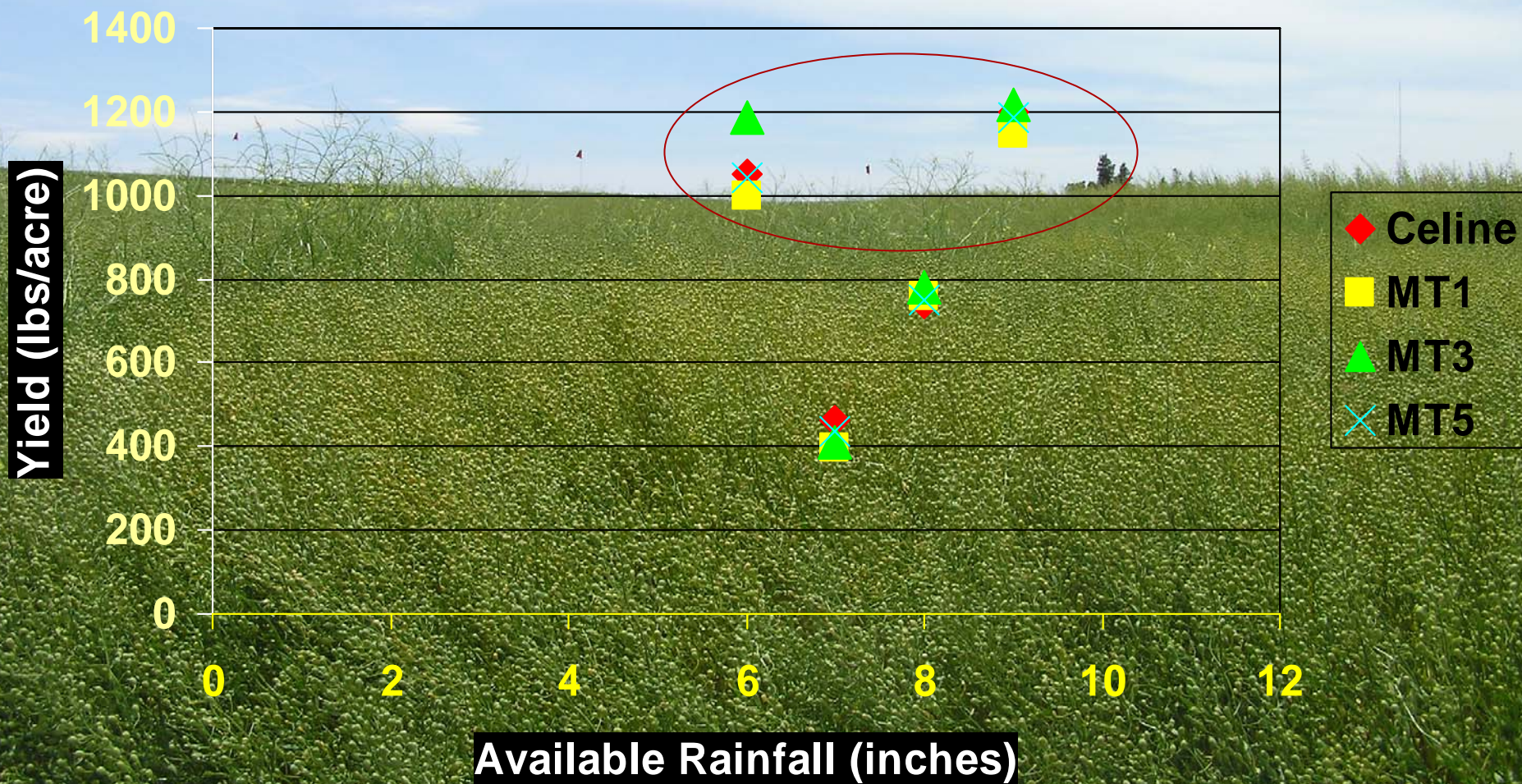
- **USDA-CSREES Special Grant: the Biobased Institute, 2002-2007**
- **Agronomics: comparison of canola, rape, flax, sunflower, safflower, soybean, crambe, camelina at 6 research centers over 3 years**
 - Camelina is the most stable and generally the highest yielder in dryland trials
- **Farm Enterprise: Estimated cost of production is less than half that of wheat and a third of canola**
 - Camelina: \$58/acre; Wheat: \$110/acre; Canola: \$135/acre
- **USDA-NPGS supplies world collection of camelina and mutations for early maturity, oil yield and omega 3 selected.**
 - 36 selections → 2 varieties developed by MSU
- **Feeding trials of meal (10-12% fat) initiated (beef, poultry, dairy goats, trout and pork): all show significant increases in long chain omega 3, surpassing flax**
- **Herbicide research initiated: post-emergent grass, preplant broadleaf: IR-4 permits applied for**

Yield Response to Nitrogen and Seeding Rate 2007

Oregon State University (Wysocki, 2007)

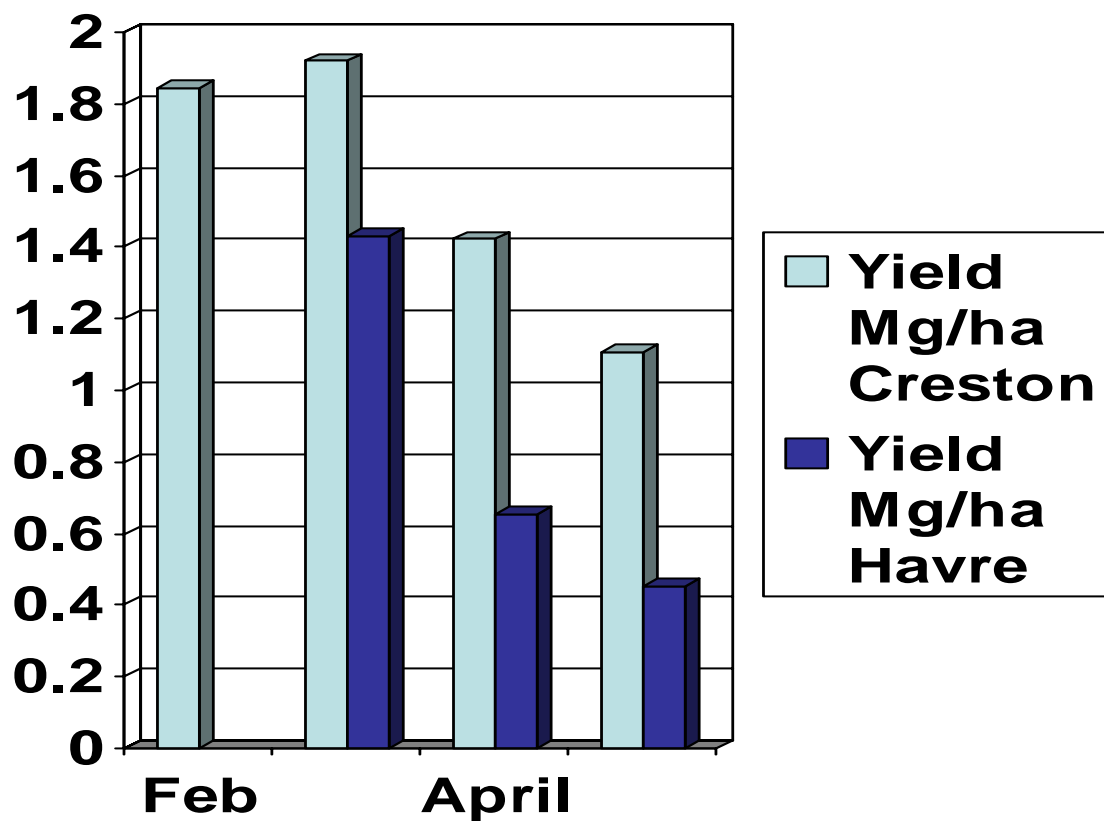
Variety Trial Yields lbs/acre			Seeding Rate Trials Yields lbs/acre			Nitrogen Fertility Trials Yields lbs/a		
Variety	Location		seeding rate (lb/acre)	Location		N rate above the field* (lb/acre)	Location	
	Pendleton	Moro		Pendleton	Moro		Pendleton	Moro
1	1169	1765	1.5	1183	2007	0	1465	2352
2	1123	1637	3.0	1197	2130	20	1390	2411
3	1008	2079	4.5	1293	2287	40	1549	2292
4	1032	2204	6.0	1200	2321	60	1472	2433
5	1058	2138	LSD	NS	NS	LSD	NS	NS
6	1168	1713	*Pendleton field = 60 lb N/acre *Moro field = 50 lb N/acre Pendleton: annual "recrop" Moro: fallow Calena was the variety in these trials All yield in lb/acre					
7	1402	1912						
8	1291	1525						
9	1214	2113						
10	1213	2278						
11	1301	2054	Pers.comm., Don Wysocki, OSU					

Relationship of Rainfall and Yield (4 locations, eastern MT and Creston)



Yield Response to Planting Date 2006

- Camelina is highly adaptable to cold seeding
- Highly frost resistant
- Seeding after March 30 resulted in yield losses of 100 lbs/week of delay (45 kgs/week)



	Eastern Montana					
	Winter Wheat	Spring Wheat	Camelina	Camelina	Canola	Barley
Revenue						
Price (\$/bu)	\$ 5.58	\$ 6.00	\$ 6.50	\$ 5.25	\$ 7.25	\$ 3.84
Price (\$/lb)	\$ 0.09	\$ 0.10	\$ 0.13	\$ 0.11	\$ 0.15	\$ 0.08
Yield (bu/ac)	40	28	27	24	25	47
Yield (lb/ac)	2,400	1,680	1,350	1,200	1,250	2,256
Total Revenue (\$/acre)	\$ 223.20	\$ 168.00	\$ 168.75	\$ 126.00	\$ 181.25	\$ 180.48
Costs						
Fall Burndown	\$ 9.52	\$ 9.52	\$ 9.52	\$ 9.52	\$ 9.52	\$ 9.52
Spring Burnoff	\$ -	\$ 4.76	\$ 4.76	\$ 4.76	\$ -	\$ -
Land Preparation	\$2.00	\$2.00	\$4.00	\$2.00	\$5.00	\$5.00
Seed Cost	\$ 15.00	\$ 15.00	\$ 3.00	\$ 3.00	\$ 30.00	\$ 14.40
Planting	\$ 10.00	\$ 10.00	\$ 10.00	\$ 5.00	\$ 10.00	\$ 10.00
Soil Testing	\$ 2.00	\$ 2.00	\$ -	\$ -	\$ -	\$ 2.00
Fertilizer	\$ 35.28	\$ 31.99	\$ 15.05	\$ 15.05	\$ 45	\$ 38.65
N (lb/ac)	54	47	23.5	23.5	56.4	75
P (lb/ac)	20	20	0	0	7.4	20
K (lb/ac)	5	5	0	0	0	0
Sulfur (lb/ac)	0	0	10	10	10	15
In-Crop Herbicide	\$ 24.00	\$ 24.00	\$ 10.00	\$ 10.00	\$ 20.00	\$ 25.84
In-Crop Insecticide	\$ 6.00	\$ 6.00	\$ -	\$ -	\$ -	\$ -
Harvest	\$ 23.94	\$ 23.94	\$ 23.94	\$ 23.94	\$ 23.94	\$ 23.94
Variable Cost (\$/ac)	\$ 127.74	\$ 129.21	\$ 80.27	\$ 73.27	\$ 131.71	\$ 139.35
Gross Margin (\$/ac)	\$ 95.46	\$ 38.79	\$ 88.49	\$ 52.74	\$ 49.54	\$ 41.13

Timetable for Planting Camelina in Montana

Planting	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	Yield lb/a
Fall (winter) Fall seeded (spring)	XXXX	XXX							800 1200 1200
Dormant seeded (spring)				XXX	XXX				1200- 2000
Early (spring)						XXX	XX		1000- 2000
Late (spring)							X	X	900- 1200

Camelina (*Camelina sativa* L.) Crantz



Tocopherol: Vitamin E

	Camelina	Flax	Canola
α-Tocopherol	7	38	37
β-Tocopherol	0	0	0
γ-Tocopherol	255	0	66
δ-Tocopherol	4	0	2
Total Vitamin E	266	38	105

Data provided by Great Northern Growers, 2005

Finished Cooked Beef Study: Camelina- versus Soybean-fed Steers (10% of complete diet)

Fatty Acid in Medium Cooked Hamburger	Camelina % of fat	Soybean Meal %of fat
Oleic (monounsaturate)	46.93	43.15
Linoleic 18:2 (polyunsaturate)	2.18	1.55
Linolenic 18:3 omega 3 (polyunsaturate)	0.61	0.63
EPA Omega 3	0.03	0.02
DHA Omega 3	0.31	0.11

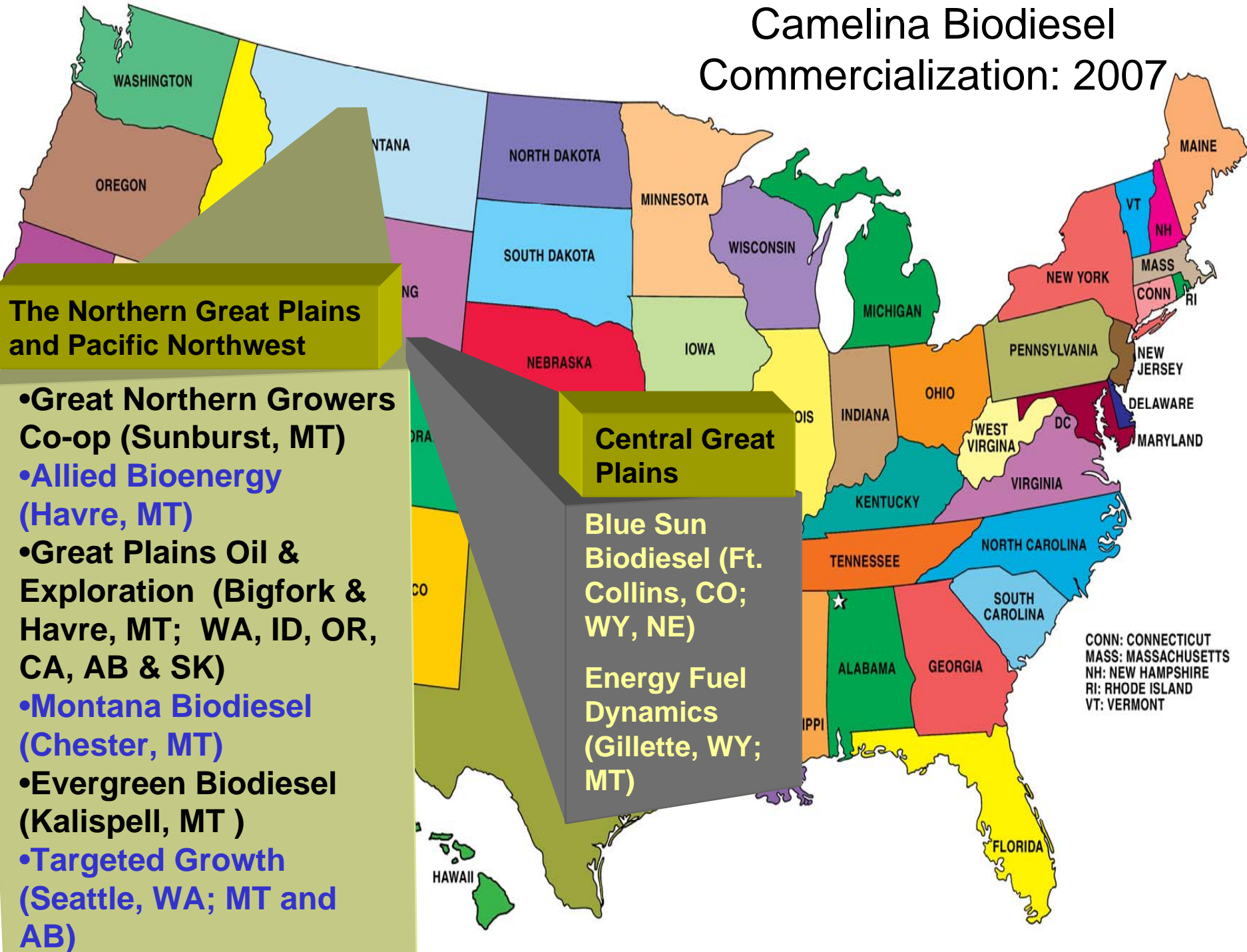
Significant differences indicated in red (probability of error=0.0001)

The Harvest

- Harvest at $< 8\%$ moisture
- Ground speed: 1.6 to 2.5 mph
- Concaves open, air reduced, Sieves nearly closed



Camelina Biodiesel Commercialization: 2007



Has This Worked?

Production Area	(2006)	Acres Planted 2007
Montana 32 growers	(4,500)	45,000 115 growers
Wyoming/Colorado 10 growers	(1,200)	3,500 22 growers
Pacific Northwest 1 grower	(50)	1,000 9 growers
Alberta/Saskatchewan 15 growers	(1,500)	12,000 45 growers

Summary

- Production is relatively easy and adaptable to current farm equipment with low input and reasonable returns to growers
- Numerous companies establishing between 2006-2007 specific to camelina, primarily for biodiesel; Montana production in 2007 was 10 times that of 2006
- Numerous uses from camelina: biofuels, omega 3 markets, and omega 3 enriched livestock industries

07/22/2007